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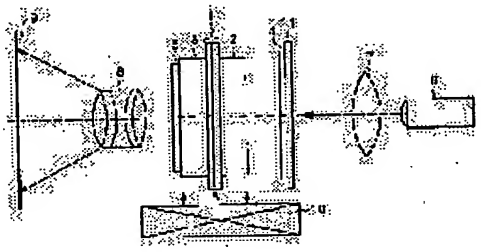
(54) PROJECTION TYPE LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To solve the problem that decrease in the reproducibility for luminance or display irregularity occurs even when intense light from a light source is supplied in a projection type liquid crystal display device, to prevent decrease in the display quality of a projected image due to dust or the like, and to always maintain the display characteristics and the display quality to the original optimum state.

SOLUTION: The coefficient of linear expansion of a first dust-proof glass 2 and a second dust proof glass 3 is specified to $\leq 1.0 \times 10^{-6}/^{\circ}$ C so that even when heat is accumulated in a light-transmitting member or a transparent substrate by supplying intense light from a light source, generation of double refraction due to the heat can be prevented. Or, by specifying the photoelastic constant of the glass to $\leq 1.0 \times 10^{-12}$/Pa, generation of double refraction can be prevented even when heat is accumulated in the light-transmitting member or the transparent substrate by supplying intense light from the light source.



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CLAIMS

[Claim(s)]

[Claim 1] The liquid crystal panel with which the pixel was arranged in the viewing area, and the light source which carries out outgoing radiation of the light towards said liquid crystal panel, It is the projection mold liquid crystal display which has the incident light study system which projects on a screen the light which outgoing radiation was carried out from said light source, and penetrated said liquid crystal panel. Among the front face of said liquid crystal panel, or a rear face, at least to either or both The projection mold liquid crystal display characterized by arranging at least the light transmission member of the board thickness which coefficient of linear expansion consists of construction material not more than 1.0x10-6/degree C, and becomes settled corresponding to the depth of field of said incident light study system at said viewing area.

[Claim 2] The projection mold liquid crystal display according to claim 1 characterized by said light transmission member being what has board thickness (0.5mm thru/or 4.5mm).

[Claim 3] The projection mold liquid crystal display according to claim 1 with which said light transmission member is characterized by being stretched by said liquid crystal panel.

[Claim 4] The liquid crystal panel with which the pixel was arranged in the viewing area, and the light source which carries out outgoing radiation of the light towards said liquid crystal panel, It is the projection mold liquid crystal display which has the incident light study system which projects on a screen the light which outgoing radiation was carried out from said light source, and penetrated said liquid crystal panel. Among the front face of said liquid crystal panel, or a rear face, at least to either or both The projection mold liquid crystal display characterized by arranging at least the light transmission member of the board thickness which a photoelasticity constant consists of construction material below 1.0x10-12 / Pa, and becomes settled corresponding to the depth of field of said incident light study system at said viewing area.

[Claim 5] The projection mold liquid crystal display according to claim 4 characterized by said light transmission member being what has board thickness (0.5mm thru/or 4.5mm).

[Claim 6] The projection mold liquid crystal display according to claim 4 with which said light transmission member is characterized by being stretched by said liquid crystal panel.

[Claim 7] The liquid crystal panel with which it has two transparence substrates which pinch a liquid crystal layer and its liquid crystal layer, and the pixel is arranged, It is the projection mold liquid crystal display which has the light source which carries out outgoing radiation of the light towards said liquid crystal panel, and the incident light study system which projects on a screen the light which outgoing radiation was carried out from said light source, and penetrated said liquid crystal panel. The projection mold liquid crystal display with which coefficient of linear expansion is less than [1.0x10-6/degree C], and either or both are characterized by being what consists of a light transmission ingredient of the board thickness which becomes settled corresponding to the depth of field of said incident light study system at least between said two transparence substrates.

[Claim 8] The projection mold liquid crystal display according to claim 7 characterized by the transparence substrate which consists of said light transmission ingredient being what has board thickness (0.5mm thru/or 4.5mm).

[Claim 9] The liquid crystal panel with which it has two transparence substrates which pinch a liquid crystal layer and its liquid crystal layer, and the pixel is arranged, It is the projection mold liquid crystal display which has the light source which carries out outgoing radiation of the light towards said liquid crystal panel, and the incident light

study system which projects on a screen the light which outgoing radiation was carried out from said light source, and penetrated said liquid crystal panel. The projection mold liquid crystal display with which photoelasticity constants are below 1.0x10-12 / Pa, and either or both are characterized by being what consists of a light transmission ingredient of the board thickness which becomes settled corresponding to the depth of field of said incident light study system at least between said two transparence substrates.

[Claim 10] The projection mold liquid crystal display according to claim 9 characterized by the transparence substrate which consists of said light transmission ingredient being what has board thickness (0.5mm thru/or 4.5mm).

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the projection mold liquid crystal display of 3 plate type which it used one sheet at a time three sheets for the sum total for every veneer type which used one liquid crystal panel, or colored light.

[0002]

[Description of the Prior Art] Generally the projection mold liquid crystal display is equipped with incident light study systems, such as a liquid crystal panel, a polarizing plate arranged at the front **** principal plane, and a projector lens which expands the light which penetrates them and is projected on a screen, and attracts attention with the comparatively small liquid crystal panel as a display which can display a big screen. The thing of the veneer type which realizes color display using a light filter etc. while the liquid crystal panel of one sheet is used for a projection mold liquid crystal display, and the thing of 3 plate type which compounds the transmitted light of those liquid crystal panels by optical system using the liquid crystal panel of three sheets corresponding to each of each colored light like R, G, and B, and realizes color display are proposed.

[0003] Since it is desirable to make high the quantity of light or the optical reinforcement supplied from the light source in order to realize legible image display by high brightness general more in such a projection mold liquid crystal display, the high power light source is used in many cases.

[0004]

[Problem(s) to be Solved by the Invention] By the way, in the above projection mold liquid crystal displays, generally, when dust etc. adhered near the front face of a liquid crystal panel, it was expanded with the projector lens etc., it was projected on the screen, and there was a problem of becoming the factor which reduces display grace remarkably.

[0005] Then, in order [of the front flesh side of a liquid crystal panel] to defocus at least so that it may not be conspicuous in a projection image even if dust etc. adheres to an image display field, the technique of arranging a transparence member like a boro-silicated glass plate is proposed. Let such a transparence member be what has the suitable thing of the board thickness which becomes settled on balance with the depth of field (depth of

focus) of an incident light study system.

[0006] However, internal stress which it originates in supplying such a strong light source light, and the temperature of a transparence member rises, and is generally called the so-called thermal stress in a projection mold liquid crystal display although it is desirable to make high the quantity of light or the optical reinforcement supplied from the light source as mentioned above occurs, and a birefringence arises in the light which penetrates the transparence member. For this reason, there is a problem that the contrast property of a projection image and the homogeneity of a display in a screen fall.

[0007] That is, generally, originally the display property about liquid crystal panels including a contrast property is set up so that the combination of a polarizing plate and a liquid crystal panel may optimize. However, if the above birefringences arise in the transparence member attached between such polarizing plates and liquid crystal panels, it will originate in the phase contrast (retardation; retardation) of the birefringence, and the rotatory-polarization property of the transmitted light will shift from the optimal conditions. In the liquid crystal panel of the result, for example, a normally white mode, it shifts in the direction in which the intensity level of a black display becomes high, and a contrast property falls and there is a problem that display grace becomes what deteriorated notably. Or in the liquid crystal panel in normally black mode, it shifts in the direction in which the intensity level of a white display becomes low, and a contrast property falls and there is a problem that display grace becomes what deteriorated notably.

[0008] Since the light absorbed by the polarizing plate becomes heat when the transparence member is especially stuck between the polarizing plate and the liquid crystal panel, internal stress arises in a transparence member with the heat, it becomes that from which the intensity level of the highest center section and the lowest periphery of an optical consistency or an accumulation consistency differed, and there is a problem that lowering of brightness repeatability or brightness unevenness, the ununiformity in a screen of a contrast property, etc. arise.

[0009] For example, in the liquid crystal panel in normally black mode, the phenomenon in which a center section becomes brighter than the brightness of an original display image arises. Moreover, the phenomenon in which a center section becomes darker than the brightness of the original display screen in the liquid crystal panel of a normally white mode at reverse arises. Consequently, in [any] the case of the mode, there is a problem that dispersion, brightness unevenness, etc. of lowering of the brightness repeatability of a projection image and the contrast property in a screen arise.

[0010] Cooling a liquid crystal panel and its circumference, using forced-air-cooling equipment etc. as a technique for solving the problem of lowering of the display property resulting from the exposure of such a strong light source light is proposed.

[0011] However, although to irradiate a still stronger light source light is desired in order to attain the further high brightness-ization of a projection image, it is in the inclination used as what has the inadequate cooling effect to the accumulation resulting from such a strong light source light. Moreover, although it is necessary to use still more powerful forced-air-cooling equipment etc. in order to acquire sufficient cooling effect, a noise, heat, etc. which are emitted [motor / for driving the blower fan for cooling etc.] become large, and the improvement in the cooling effect has actual already become a thing near a limitation.

[0012] Moreover, if a strong cooling wind is ventilated in order to acquire the strong cooling effect, it may originate in friction of the air at the time of the air blasting etc., dust may be charged, and the probability to adhere to a liquid crystal panel, the front face of a polarizing plate, etc. may become high. And generally, since the velocity distribution near the objective front face is 0, it becomes what has a difficult actual top to blow away the dust which once adhered to the front face therefore in the style of cooling.

[0013] Or although cooling techniques other than forced-air-cooling equipment are also considered, it is very difficult to cool without interrupting optically the front face of a liquid crystal panel or a polarizing plate. For example, in a thing like a water cooler, it is difficult to make it not bar the light transmission of the viewing area of a liquid crystal panel, and since the structure makes it complicated extremely, it is not practical. Therefore, as a cooling technique, there is no practical thing in addition to forced-air-cooling equipment.

[0014] Thus, even if it used forced-air-cooling equipment etc., solving lowering and the display unevenness of the brightness repeatability resulting from the accumulation by supply of the strong above light source light had the problem of being difficult. Moreover, there was a problem that it was difficult to solve deterioration of the display grace resulting from the dust which adheres on the surface of a liquid crystal panel etc.

[0015] This invention was made in view of this trouble, and it is to cancel deterioration of the display grace of the projection image resulting from dust etc., and offer the projection mold liquid crystal display which can always maintain a display property and display grace at the optimal original setting out while it solves the problem that where of lowering and the display unevenness of brightness repeatability arise, even if the object supplies a strong light source light.

[0016]

[Means for Solving the Problem] The liquid crystal panel with which, as for the projection mold liquid crystal display by this invention, the pixel was arranged in the viewing area, It is the projection mold liquid crystal display which has the light source which carries out outgoing radiation of the light towards the liquid crystal panel, and the incident light study system which projects on a screen the light which outgoing radiation was carried out from the light source, and penetrated said liquid crystal panel. The light transmission member of the board thickness which coefficient of linear expansion becomes either or both from the construction material not more than 1.0x10-6/degree C, and becomes settled corresponding to the depth of field of an incident light study system is arranged at least among the front face of a liquid crystal panel, or the rear face at the viewing area.

[0017] The liquid crystal panel with which, as for the projection mold liquid crystal display by this invention, the pixel was arranged in the viewing area, It is the projection mold liquid crystal display which has the light source which carries out outgoing radiation of the light towards the liquid crystal panel, and the incident light study system which projects on a screen the light which outgoing radiation was carried out from the light source, and penetrated the liquid crystal panel. The light transmission member of the board thickness which a photoelasticity constant becomes either or both from the construction material below 1.0x10-12 / Pa, and becomes settled corresponding to the depth of field of an incident light study system is arranged at least among the front face of a liquid crystal panel, or the rear face at the viewing area.

[0018] The liquid crystal panel with which the projection mold liquid crystal display by this invention has two transparence substrates which pinch a liquid crystal layer and its liquid crystal layer, and the pixel is arranged, It is the projection mold liquid crystal display which has the light source which carries out outgoing radiation of the light towards the liquid crystal panel, and the incident light study system which projects on a screen the light which outgoing radiation was carried out from the light source, and penetrated the liquid crystal panel. Between two transparence substrates, at least, coefficient of linear expansion is less than [1.0x10-6/degree C], and either or both consist of a light transmission ingredient of the board thickness which becomes settled corresponding to the depth of field of an incident light study system.

[0019] The liquid crystal panel with which the projection mold liquid crystal display by this invention has two transparence substrates which pinch a liquid crystal layer and its liquid crystal layer, and the pixel is arranged, It is the projection mold liquid crystal display which has the light source which carries out outgoing radiation of the light towards the liquid crystal panel, and the incident light study system which projects on a screen the light which outgoing radiation was carried out from the light source, and penetrated said liquid crystal panel. Either or both consist of a light transmission ingredient which photoelasticity constants are below 1.0x10-12 / Pa, and has the board thickness which becomes settled corresponding to the depth of field of an incident light study system at least between two transparence substrates.

[0020] With the projection mold liquid crystal display by this invention, as for the light transmission member or the transparence substrate, the board thickness is set up on balance with the depth of field of an incident light study system. Furthermore, the light transmission member or the transparence substrate is set as board thickness by which it is defocused in a projection image by the detail, even if dust etc. adheres. Thereby, even if dust etc. adheres, it becomes possible to prevent the display grace of a projection image falling.

[0021] And the light transmission member or a transparence substrate becomes possible [preventing generating

of the birefringence resulting from it], even if an accumulation phenomenon arises from the light source in a light transmission member or a transparence substrate by supplying a strong light, since coefficient of linear expansion is set as less than [1.0x10-6/degree C]. Or since the photoelasticity constant of a light transmission member or a transparence substrate is set to below 1.0x10-12 / Pa, even if an accumulation phenomenon arises from the light source in a light transmission member or a transparence substrate by supplying a strong light, it becomes possible to prevent generating of the birefringence resulting from it.

[0022] In addition, although board thickness effective while defocusing the above dust, in order to prevent generating of a birefringence becomes settled by the balance of coefficient of linear expansion or a photoelasticity constant, and the magnitude of the adhering dust and the depth of field of an incident light study system, it is desirable to set it as 0.5mm thru/or 4.5mm as practically effective range.

[0023] Moreover, by considering as the condition of having made the liquid crystal panel rivaling and having stuck the light transmission member, it becomes possible to make not only a liquid crystal panel but a light transmission member distribute the heat which originates in supply of a strong light source light, and is produced, and it becomes possible to suppress the temperature rise of a liquid crystal panel and a light transmission member.

[0024]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained to a detail with reference to a drawing.

[0025] (Gestalt of the 1st operation)

[0026] Drawing 1 expresses an example of the outline configuration of the projection mold liquid crystal display concerning the gestalt of operation of the 1st of this invention. This projection mold liquid crystal display is a veneer-type projection mold liquid crystal display, and equips that body with a liquid crystal panel 1, the 1st protection-against-dust glass (light transmission member) 2, the 2nd protection-against-dust glass 3 (light transmission member), the incidence side polarizing plate 4, the outgoing radiation side polarizing plate 5, the light source 6, a condenser lens 7, the projection lens system 8 (incident light study system), and forced-air-cooling fan equipment 10.

[0027] The light source 6 supplies light source light to a liquid crystal panel 1 through a condenser lens 7, and in order to obtain the high projection image of brightness generally, it is set up so that outgoing radiation of the strong light source light may be carried out.

[0028] Although a liquid crystal panel 1 omits the detailed graphic display of the internal structure, it is the general thing which equipped the body with the transparence substrate with which the liquid crystal layer of TN mold (twist pneumatic mold), the TFT component (Thin Film Transistor) which switches liquid crystal applied voltage to the pixel electrode which pinches it and constitutes a pixel, or it were arranged, the sealing agent which closes the perimeter, and the light filter for coloring the transmitted light for each pixel of every. The location in which each pixel of this liquid crystal panel 1 is formed serves as an image formation side (focal location) of the projection lens system 8. In addition, as this liquid crystal panel 1, it cannot be overemphasized that the thing of various methods, such as the simple matrix liquid crystal panel 1 of a STN mold, other than the so-called TN type of TFT-liquid-crystal panel 1 can be applied.

[0029] The incidence side polarizing plate 4 is stuck on the glass plate 11 which is a base material, is installed in the optical plane-of-incidence side of a liquid crystal panel 1, makes only the component of the polarization direction of this polarizing plate penetrate from the light source light supplied from the light source 6, and carries out incidence to a liquid crystal panel 1. In addition, in order to compensate the so-called retardation produced in the path of light, it cannot be overemphasized that a phase contrast compensating plate etc. may be further installed with this incidence side polarizing plate 4.

[0030] The light of a liquid crystal panel 1 sticks on the front face of the side which carries out incidence, is put together, and is in the 1st protection-against-dust glass 2 (stretched). Moreover, the 2nd protection-against-dust glass 3 is stuck on the front face of the side in which the light of a liquid crystal panel 1 carries out outgoing radiation. This 1st protection-against-dust glass 2 and the 2nd protection-against-dust glass 3 are formed in order to defocus that dust etc. so that it may be conspicuous in a projection image and image formation may not

be carried out to the field currently stuck on the liquid crystal panel 1, even if dust which is floating the inside of air on the front face of the side which objection has exposed adheres. Although those board thickness becomes settled corresponding to the depth of field of the projection lens system 8, and the magnitude of dust, it is set as the range of 1mm - 4mm as board thickness which can defocus such dust based on the depth of field of the projection lens system 8 and the average value of the magnitude of dust which are generally used. Furthermore, as for this 1st protection-against-dust glass 2 and the 2nd protection-against-dust glass 3, the glass plate or photoelasticity constant not more than 1.0x10-6/degree C consists [coefficient of linear expansion] of a glass plate of 1.0x10-12 / Pa.

[0031] The outgoing radiation side polarizing plate 5 is stuck so that it may stick to the 2nd protection-against-dust glass 3, and it absorbs the light which passed the liquid crystal panel 1, without carrying out the rotatory polarization. For example, in the pixel of a black display, the light penetrated without carrying out the rotatory polarization in a liquid crystal layer is almost altogether absorbed by this outgoing radiation side polarizing plate 5. The light absorbed at this time changes to heat energy, and diffuses and goes to this outgoing radiation side polarizing plate 5, a liquid crystal panel 1, or the 2nd protection-against-dust glass 3. Moreover, the component of the light absorbed without the incidence side polarizing plate's 4 penetrating that incidence side polarizing plate 4 similarly changes to heat energy, and spreads and goes to this incidence side polarizing plate 4, a liquid crystal panel 1, or the 1st protection-against-dust glass 2. Those heat energy makes the temperature of the outgoing radiation side polarizing plate 5, the incidence side polarizing plate 4, a liquid crystal panel 1, the 1st protection-against-dust glass 2, the 2nd protection-against-dust glass 3, etc. rise.

[0032] In order to prevent carrying out accumulation of the heat generated as mentioned above to liquid crystal panel 1 grade, forced-air-cooling fan equipment 10 is the style of cooling, and carries out air cooling of them. It cannot be overemphasized that a centrifugal fan may be used and an axial-flow-fan type blower may be used as this forced-air-cooling fan equipment 10. Anyway, as [so that the optical property of the liquid crystal layer of a liquid crystal panel 1 has an adverse effect to a projection image and it may not change], this forced-air-cooling fan equipment 10 carries out air cooling of that liquid crystal panel 1, and it is set up so that noises like a fluid, such as an electric or mechanical noise by the motor for rotating a fan and a swish, etc. may not occur practically, while being set up so that accumulation may be prevented.

[0033] Next, that outline is explained focusing on the operation defocused so that image formation especially of the dust may not be carried out to a projection image, and the operation it is made not to generate the birefringence resulting from accumulation about an operation of the projection mold liquid crystal display concerning the gestalt of this 1st operation.

[0034] The temperature of the liquid crystal panel 1 in a projection mold liquid crystal display, the polarizing plate of the neighborhood, etc. will rise by no less than 10-45 degrees C compared with whenever [room air temperature] (temperature in the condition that light is not supplied), if light is supplied from the light source 6. Thus, when temperature rose; this invention persons checked becoming the factor which internal stress which is called the so-called thermal stress to glass plates, such as boro-silicated glass, arises [factor], and makes the light in which it penetrates a glass plate produce a birefringence in a various experiment, its analysis, etc.

[0035] The birefringence delta resulting from the internal stress in protection-against-dust glass, such as such a glass plate, can be expressed like the following formula. Namely, [0036]

delta=(2 pi/lambda) xBx(sigma1-sigma2) xt [0037] The wavelength of the light (light source light) by which lambda is supplied here from the light source 6, and B are the photoelasticity constant of a transparence substrate, and sigma1. The internal stress of the polarizing plate absorption shaft orientations in protection-against-dust glass, and sigma2 The internal stress of the polarization shaft orientations of the polarizing plate in protection-against-dust glass and t are the board thickness of protection-against-dust glass.

[0038] Although it turns out in the above-mentioned formula that Birefringence delta can be made small if board thickness t of the protection-against-dust glass of the conventional construction material is made thin It becomes what has the operation (defocusing operation) inadequate when it is made thin too much which removes the dust which adheres to a front face as protection-against-dust glass from the depth of field of the projection

lens system 8. Image formation of the projection image of dust will be carried out, and the display grace of a projection image is made to fall into the image on which it is projected by screen 9 grade.

[0039] Or while making thin board thickness t of protection-against-dust glass, from the front face of a liquid crystal panel 1, only the distance from which a defocusing operation practical at least is acquired is detached, the protection-against-dust glass is installed, and closing the perimeter of the gap of the protection-against-dust glass and liquid crystal panel 1 so that dust etc. may not invade is also considered.

[0040] However, if a gap is given in this way, thermal conductivity may fall in the gap, stripping of the heat from a liquid crystal panel 1 may be barred, or the air currently closed by the gap may carry out accumulation, and the temperature of a liquid crystal panel 1 may rise further. Thus, when the temperature of liquid crystal panel 1 the very thing rises, the optical property of a liquid crystal layer will change, and it will become the different brightness property and different contrast property from original setting out, as a result display grace will fall.

[0041] Or although it examined predicting beforehand the birefringence delta generated corresponding to a specific temperature rise, and arranging beforehand the phase contrast compensating plate for compensating the birefringence delta etc. generally, since the degree which the birefringence delta resulting from lifting and it of temperature in a projection mold liquid crystal display generates boils many things and changes on balance with the activity duration time of the projection mold liquid crystal display, or an OAT the birefringence delta actually generated even if it forms the phase contrast compensating plate for compensating the specific birefringence delta etc. fixed — current events — since it changes every moment, it does not necessarily restrict that effective phase contrast compensation can be performed, but a display property may vary in time rather

[0042] while set it as the thickness from which practically sufficient defocusing operation be acquire in the board thickness of protection against dust glass as a result of it examine such various points, even if temperature rose more than 10 – 45 degrees C or it from a room temperature, this invention persons found out the conditions which produce only a birefringence with the small extent which be satisfactory practically, and got the conclusion that it be suitable to form protection against dust glass with the ingredient which fulfill such conditions. And it checked that the projection mold liquid crystal display using the protection-against-dust glass of such setting out could be produced actually, the experiment which supplies a strong light source light which can obtain a projection image with brightness high enough to it could be tried, and a display property could be kept good under the conditions which are easy to produce such a temperature rise.

[0043] Furthermore, in the detail, while setting the board thickness t of the 1st protection-against-dust glass 2 and the 2nd protection-against-dust glass 3 as 1.0mm – 4.0mm, the conclusion that it was suitable that below 1.0x10-12 / Pa, or coefficient of linear expansion shall consist [a photoelasticity constant] the construction material of boro-silicated glass of the construction material not more than 1.0x10-6/degree C was obtained.

[0044] Namely, in the above-mentioned formula, if it goes too far in saying and the photoelasticity constant B (or coefficient of linear expansion) will be set to 0, no matter board thickness t may be what thickness, Birefringence delta can be set to 0. However, the transparence member of construction material [as / the photoelasticity constant B or whose coefficient of linear expansion is 0] is not actually possible actually. Then, the range of the suitable value of the photoelasticity constant which can maintain Birefringence delta at a low value which does not have a practical adverse effect to the display grace of a projection image corresponding to this board thickness after setting to t= 1.0-4.0mm board thickness from which defocusing operation sufficient first practically is acquired, or coefficient of linear expansion was examined. Consequently, less than [1.0x10-6/degree C], then a good thing were checked [constant / photoelasticity] in below 1.0x10-12 / Pa, or coefficient of linear expansion.

[0045] Drawing 2 is a graph showing the experimental result of brightness (illuminance) change of the black display to the time amount progress when displaying a projection image actually with the projection mold liquid crystal display constituted using the 1st protection-against-dust glass 2 and the 2nd protection-against-dust glass 3 which fulfill the conditions of the above board thickness and a photoelasticity constant. In the experiment which showed the result, the boro-silicated glass of setting out of t= 3.3mm [of board thickness] and photoelasticity constant B=0.43x10-12 / Pa, and coefficient-of-linear-expansion alpha=12.4x10-6/degree C was

used for this drawing 2 as the 1st protection-against-dust glass 2 and 2nd protection-against-dust glass 3. In this case, the photoelasticity constant B fulfills the conditions of the above-mentioned suitable value.

[0046] Moreover, drawing 3 is a graph showing the experimental result of brightness (illuminance) change of the black display to the time amount progress when displaying a projection image actually with the projection mold liquid crystal display constituted using the 1st protection-against-dust glass 2 and the 2nd protection-against-dust glass 3 which fulfill the conditions of the above board thickness and coefficient of linear expansion. In the experiment which showed the result, the boro-silicated glass of setting out of t= 3.3mm [of board thickness] and photoelasticity constant B=3.5x10-12 / Pa, and coefficient-of-linear-expansion alpha=0.7x10-6/degree C was used for this drawing 3 as the 1st protection-against-dust glass 2 and 2nd protection-against-dust glass 3. In this case, coefficient of linear expansion alpha fulfills the conditions of the above-mentioned suitable value.

[0047] In addition, at drawing 2 and drawing 3 , while the plot of a round mark shows the intensity level of the center section of the projection screen, the plot of the triangle mark shows the intensity level of a periphery.

[0048] It was checked that in any [these] case the intensity level is mostly kept constant by both the center section and the periphery even if time amount passes so that clearly [drawing 2 and drawing 3].

[0049] On the other hand, as an example of a comparison, although board thickness was t= 3.3mm like the above, it used the protection-against-dust glass which consists of the conventional boro-silicated glass of setting out of photoelasticity constant B=4.0x10-12 / Pa, and coefficient-of-linear-expansion alpha=3.3x10-6/degree C instead of the 1st protection-against-dust glass 2 concerning above-mentioned this invention, and the 2nd protection-against-dust glass 3, and conducted the experiment under the same conditions as the above. Consequently, as shown in drawing 5 , after starting the display, especially in connection with the passage of time, the intensity level of the middle-of-the-screen section changed substantially, and it was checked that display grace falls notably. Moreover, also about the periphery, several % - about 10% of change was seen. In addition, as the temperature measured on a protection-against-dust glass front face at this time shows that measurement result to drawing 6 , it is both a center section and the periphery of protection-against-dust glass, and it became clear that about 10% of temperature rise had arisen with both time amount progress.

[0050] thus, as a result of comparing with the case of the projection mold liquid crystal panel 1 using conventional protection-against-dust glass, in the projection mold liquid crystal display concerning the gestalt of this operation By considering the photoelasticity constant B or coefficient of linear expansion alpha, and board thickness t as the above setting out Even if it originates in having supplied a strong light source light and temperature rises, a birefringence can be prevented from being generated on the 1st protection-against-dust glass 2 or the 2nd protection-against-dust glass 3. As a result, it was checked that generating of lowering of the brightness property of a projection image or a contrast property, change of display unevenness or the display property accompanying time amount progress, etc. is cancelable.

[0051] Moreover, since it sticks so that the 1st protection-against-dust glass 2 and the 2nd protection-against-dust glass 3 may be stuck on the principal plane (a front face or rear face) of a liquid crystal panel 1. Even if a strong light source light is supplied and the most changes to heat energy, accumulation of the heat energy is not carried out to a liquid crystal panel 1, but board thickness can also make t= 1.0-4.0mm, the 1st protection-against-dust glass 2 with heat capacity it is thick and big, and the 2nd protection-against-dust glass 3 distribute it. Furthermore, heat can be radiated outside from the side face of the 1st protection-against-dust glass 2 or the 2nd protection-against-dust glass 3 etc.; and the temperature rise of the liquid crystal panel 1 with which these very thing and it are stuck can be prevented. Consequently, it becomes possible to prevent change of the rotatory-polarization property resulting from the temperature change of a liquid crystal panel 1.

[0052] (Gestalt of the 2nd operation)

[0053] Drawing 4 expresses an example of the outline configuration of the projection mold liquid crystal display concerning the gestalt of operation of the 2nd of this invention.

[0054] The projection mold liquid crystal display concerning the gestalt of this 2nd operation is a projection mold liquid crystal display of 3 plate type equipped with the cross prism 12 which compounds the light which was able to give the image component for every color through liquid crystal panel of these three sheets 1' while equipping

it at a time with one liquid crystal panel of a total of three sheets 1' for every colored light, respectively.

[0055] As a different point from the projection mold liquid crystal display applied to the gestalt of implementation of the above 1st among the bodies of the projection mold liquid crystal display concerning the gestalt of this 2nd operation It says [that liquid crystal panel 1' omits a light filter], I hear that the light which penetrated that colored light different, respectively is supplied to every [which is the each] liquid crystal panel 1', and liquid crystal panel of these three sheets 1', respectively is compounded by the cross prism 12, and it projects towards a screen 9, and it is. moreover — incidence — a side — a polarizing plate — four — ' — a — four — ' — b — four — ' — c — and — outgoing radiation — a side — a polarizing plate — five — ' — a — five — ' — b — five — ' — c — the — one — protection against dust — glass — two — ' — a — two — ' — b — two — ' — c — the — two — protection against dust — glass — three — ' — a — three — ' — b — three — ' — c — a liquid crystal panel — one — ' — a — one — ' — b — one — ' — c — sticking — without — having separated — a location — It is supported by support plate 11'a, 11'b, and 11'c. About other outline configurations, it is the same as that of the thing of the gestalt of implementation of the above 1st.

[0056] In such a projection mold liquid crystal display of 3 plate type It differs from the veneer-type projection mold liquid crystal display stated to the gestalt of implementation of the above 1st. incidence — a side — a polarizing plate — four — ' — a — four — ' — b — four — ' — c — outgoing radiation — a side — a polarizing plate — five — ' — a — five — ' — b — five — ' — c — the absorption of light — having originated — the — one — protection against dust — glass — two — ' — a — two — ' — b — two — ' — c — the — two — protection against dust — glass — three — ' — a — three — ' — b — three — ' — c — the very thing — a temperature rise — and — accumulation — being generated — things — being few — although — for example, when liquid crystal panel 1'a, 1'b, and 1'c are TFT molds Light source light is absorbed by the black matrix (protection-from-light layer) of the interior, and liquid crystal panel 1'a, 1'b, and 1'c carry out accumulation. the — heat — front — a flesh side — sticking — having — **** — the — one — protection against dust — glass — two — ' — a — two — ' — b — two — ' — c — the — two — protection against dust — glass — three — ' — a — three — ' — b — three — ' — c — spreading — the — temperature — going up — making — ******** . moreover — very — being strong — the light source — light — irradiating — a case — etc. — **** — the — one — protection against dust — glass — two — ' — a — two — ' — b — two — ' — c — the — two — protection against dust — glass — three — ' — a — three — ' — b — three — ' — c — the very thing — the light source — light — a part — heat — changing — accumulation — carrying out — having — ******** . therefore — being such — three — plates — a type — projection — a mold — a liquid crystal display — a case — being strong — the light source — light — supply — originating — the — one — protection against dust — glass — two — ' — a — two — ' — b — two — ' — c — the — two — protection against dust — glass — three — ' — a — three — ' — b — three — ' — c — a birefringence — it may be generated .

[0057] then — being such — three — plates — a type — projection — a mold — a liquid crystal display — a case — **** — the — one — protection against dust — glass — two — ' — a — two — ' — b — two — ' — c — the — two — protection against dust — glass — three — ' — a — three — ' — b — three — ' — c — the above — the — one — operation — a gestalt — being the same — setting out — ** — carrying out — things — them — the — one — protection against dust — glass — two — ' — a — two — ' — b — two — ' — c — the — two — protection against dust — glass — three — ' — a — three — ' — b — three — ' — c — a birefringence — not being generated — making — As a result, lowering of the brightness property of a projection image, lowering of a contrast property, or change of display unevenness or the display property accompanying time amount progress is cancelable.

[0058] In addition, while it is possible as board thickness of protection-against-dust glass to attain the above defocusing operations As [be / controlling generating of a birefringence on balance with setting out of the above photoelasticity constants or coefficient of linear expansion / possible] As a result of examining the practical minimum value and a practical peak price, that what is necessary is just to set it as the range of t= 0.5mm - 4.5mm of board thickness If the allowances for corresponding when light source luminous-intensity buildup and a room temperature furthermore rise, or when the magnitude of dust is still larger were expected, it was checked by

various experiments etc. that what is necessary is just to set it as the range of t= 1.0mm – 4.0mm of board thickness as mentioned above.

[0059] Moreover, although protection-against-dust glass is stuck on the transparence substrate of a liquid crystal panel and was used for it with the gestalt of the above-mentioned implementation, the protection-against-dust glass which equipped the transparence substrate of a liquid crystal panel itself with properties, such as the above board thickness and a photoelasticity constant, may be used. By adopting such a configuration, since structure of a projection mold liquid crystal display can be made simple, it is desirable.

[0060] Moreover, although it arranges with the gestalt of the above-mentioned implementation so that protection-against-dust glass may be stuck on the surface of a liquid crystal panel and may be stuck, protection-against-dust glass is not necessarily limited only to making it stick to a liquid crystal panel, but may separate and arrange spacing. In the case of Perilla frutescens (L.) Britton var. crispa (Thunb.) Decne., since distribution of the heat from a liquid crystal panel to protection-against-dust glass may become difficult, it may merely be necessary to take the measures against heat dissipation from such a liquid crystal panel. However, it is possible to set the protection-against-dust glass as thin board thickness, such as 1.0 etc.mm, as much as possible, and to enable it to use it to the construction material of the upper limit of the tolerance of a photoelasticity constant or coefficient of linear expansion etc., separating protection-against-dust glass from the front face of a liquid crystal panel, arranging it in this way, and securing a practical defocusing operation, when such a cure is possible, or when the property of a liquid crystal panel does not change substantially in accumulation to that extent.

[0061] Moreover, although the gestalt of the above-mentioned implementation described the case where boro-silicated glass was used as protection-against-dust glass, it cannot be overemphasized that it is not limited only to the protection-against-dust glass of such glass construction material as a light transmission member. In addition, if the conditions of the above photoelasticity constants or coefficient of linear expansion are fulfilled, it is possible to apply a quartz plate, an artificial quartz plate, etc., for example etc.

[0062] Moreover, as a liquid crystal panel, it cannot be overemphasized that it is not limited only to the TFT-liquid-crystal panel of the above TN molds. In addition, the thing of various methods (structure and method of presentation), such as a liquid crystal panel using strong dielectric liquid crystal, is applicable, for example.

[0063]

[Effect of the Invention] As explained above, according to the projection mold liquid crystal display according to claim 1 to 10 By setting the light transmission member or the transparence substrate as board thickness by which it is defocused in a projection image even if dust etc. adheres While doing so the effectiveness that deterioration of the display grace of the projection image resulting from adhesion of dust etc. is cancelable Even if it supplies a strong light from the light source, by suppressing the birefringence produced in a light transmission member or a transparence substrate to extent which does not have an adverse effect in a display, the effectiveness that a display property and display grace can always be maintained at the optimal original setting out is done so.

[0064] Moreover, since the transparence substrate which constitutes some liquid crystal panels is used as the above light transmission members, while doing so the same effectiveness as the above-mentioned light transmission member especially according to the projection mold liquid crystal display according to claim 7 to 10, the effectiveness that the configuration of this projection mold liquid crystal display can be made brief is further done so.

[0065] Moreover, according to the projection mold liquid crystal display according to claim 3 or 6, especially By changing into the condition of having made the liquid crystal panel rivaling and having stuck the light transmission member, and making not only a liquid crystal panel but a light transmission member distribute the heat which originates in supply of a strong light source light, and is produced The effectiveness that generating of the birefringence which could suppress the temperature rise of a liquid crystal panel and a light transmission member further in addition to the above effectiveness, as a result originated in accumulation can be prevented is done so.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the outline configuration of the projection mold liquid crystal display concerning the gestalt of operation of the 1st of this invention.

[Drawing 2] It is drawing showing the experimental result of brightness change of the black display to the time amount progress when displaying a projection image with the projection mold liquid crystal display using protection-against-dust glass which fulfills the conditions of the photoelasticity constant B.

[Drawing 3] It is drawing showing the experimental result of brightness change of the black display to the time amount progress when displaying a projection image with the projection mold liquid crystal display using protection-against-dust glass which fulfills the conditions of coefficient of linear expansion alpha.

[Drawing 4] It is drawing showing the outline configuration of the projection mold liquid crystal display concerning the gestalt of operation of the 2nd of this invention.

[Drawing 5] It is drawing showing the experimental result of brightness change of the black display to the time amount progress when displaying a projection image as an example of a comparison with the projection mold liquid crystal display using conventional protection-against-dust glass.

[Drawing 6] It is drawing showing the temperature change of the protection-against-dust glass front face accompanying the time amount progress when displaying a projection image with a projection mold liquid crystal display.

[Description of Notations]

1 [— An incidence side polarizing plate 5 / — An outgoing radiation side polarizing plate, 6 / — The light source, 7 / — A condenser lens, 8 / — A projection lens system, 10 / — Forced-air-cooling fan equipment] — A liquid crystal panel, 2 — The 1st protection-against-dust glass, 3 — The 2nd protection-against-dust glass, 4

[Translation done.]